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The Relational Species Concept

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Abstract
In this paper, I argue that biological species are best understood in terms of relations of similarity that are contextually selected. In particular, I maintain that a species is a population of organisms resembling each other relatively to a cluster of properties. Which cluster is relevant is decided contextually on the basis of three factors: the properties that are of interest to the classifier, the regions of space-time relative to which the classification is carried on, and the population of organisms under consideration. In the conclusive part of the paper, I show the advantages of a relational species concept over the typological one.

1. Introduction

What is a species? If one were to ask this question to some scientist working with species, until a few decades ago, the answer would have probably been something like the following:

(T) A species is a cluster of intrinsic properties, the possession of which by a given individual is a necessary and sufficient condition for belonging to the species.

Sure, some may have preferred to substitute "cluster" with "set" or "conjunction", and others may have also added that the concept of species expressed in (T) serves to find the *ideal* member of the species, so that (T) leaves room for the existence of *deviant* members. But, putting on a side such details for a moment, the core idea of the answer was shared. According to (T), a species *taxa* aims at capturing a number of intrinsic properties that all and only the individuals within a given species possess; two individuals belong to the same species in virtue of their *sharing* the characteristic properties of that species; furthermore, each individual

belongs to one and only one species. Thus, according to (T), the world is divided into types (it does not matter how large or small they are) of individuals, and species *taxa* aims at capturing such types. This is, briefly, the typological species concept (cfr. Sober 1978, Ruse 1987 and Kitcher 1984).

Over the last few decades, especially because of the better understanding of the patterns of variation within populations, serious doubts were cast on the plausibility of the typological species concept. To cut a long story short, there seems to be no general method of abstracting from the *spectrum* of variation within the population of a given species a number of properties that the *ideal* member of the species possesses. Populations of organisms are continuously changing, also with respect to the properties which are relevant to the classificatory purposes of biologists; because the amount of variation is often massive, none of the stages in the change of the population can be neatly isolated and regarded as more relevant – this should be well known to all those who attempted at contructing a cladogram for species. From the theoretical point of view this means that, on the basis of the current scientific activity, there are strong reasons to believe that (T) is not correct – i.e. there is little or no evidence that for any two organisms within the same species there is a cluster of intrinsic porperties that they share.

Even if such a negative result has nowadays been broadly accepted by the scientific community, no agreement over an alternative has yet been reached. If you open a biology book or you take a class in biology, you will be presented with a list of ways of conceiving species. Some of them carry a more robust metaphysical commitment as to what kind of properties are relevant for classificatory purposes (phenotypical or genotypical) or as to what type of spatio-temporal relations have to hold among the individuals of a same species. Belong to this first type of species concept the morphological species concept, the biological species concept, the evolutionary species concept, the phylogenetic species concept, the genotypic species concept, the ecological species concept, the recognition species concept, the cohesion species concept.***[1]*** A second type of proposals take a more pragmatic or pluralistic stance, giving up the idea of there being some metaphysical features peculiar to all species. The nominalist species concept and the taxonomic species concept belong to this second type, together with every pluralistic approach.***[2]*** I share with these latter the conviction that fairly each of the species concept belonging to the first group accommodate some genuine scientific purposes and, hence, cannot be blamed for inconsistency. What each of them lacks is *completeness*. For example, the biological species concept, being centered on the concept of 'interbreeding',***[3]*** cannot account for asexual organisms; the ecological concept, being grounded on the concept of 'niche' or 'environment',***[4]*** is too fine grained when it comes to account for similarities (of phenotypical traits, of capacities, of habits) among organisms living in different environments; the individual species concept put forward by David Hull, according to which species – like individuals – are spatio-temporally continuous entities,***[5]*** cannot countenance the possibility of a scenario of the *Jurassic Park* type, in which an old species is brought back to existence.

Where I depart from the pragmatic or pluralistic approaches is when it comes to the lesson to draw from the lack of completeness or generality of the metaphysically

more pregnant tentatives. I agree that, maybe, we should give up the hope of finding a *type* of properties indicating the species of an organism and – depending on one's own views – we should give up also the idea that species are natural kinds. However, this does not countenance that no metaphysical characterization of species can be provided. 'Species' is not just a convenient label we attach to a metaphysically blind classification of organisms; the use we make of such term is grounded on similarities among organisms and constrained by other metaphysical assumptions regarding the spatio-temporal relations of organisms belonging to the same species.

In accordance with such remarks, I will attempt to furnish a species concept that, as a pragmatic or a pluralistic approach, poses itself at a higher level with respect to the proposals included in the first group, yet I will try to provide a metaphysically pregnant conception of species. The label I reserved for my attempt is *the relational species concept*, and I define it this way:

(R) A species is a population of organisms resembling each other relatively to a cluster of properties

Two elements characterize (R). (i) The relation of similarity – the type of similarity involved and the properties characterizing it; (ii) a conception of the population of a species - grounded on the characterization of the space-time regions relevant for classificatory purposes. Two points of my proposal should be made clear since the beginning. These elements constitute two metaphysical constraints that every lower level species concept must satisfy. In this sense, my attempt will have a more normative flavour than a pluralistic approach - according to which *everything goes*. Also, the relation of similarity and the conception of population that I will endorse are grounded on the *actual* world. The concept of species we aim at capturing does not include the classificatory schemas we would have had, *were the earth* been endowed with completely different physical or biological properties. Empirical science is concerned with the actual world (even though it uses possibility as an euristic tool); thus, the terms employed in current scientific practice should be elucidated on the basis of what is going on in the actual world.

2. The Relation of Similarity

Resemblance is a non-symmetric, non-transitive, vague and context-relative relation. Let us consider first the latter two. Often, it is vague whether a given organism belongs to one species or another.

According to the typological account, there is always a fact of the matter as to whether an organism has or lacks the properties required to be included in a certain species. The vagueness, therefore, has to be attributed to the lack of some data, so that,

once our knowledge of the organisms under consideration will be improved, we will be able to settle the question.

Unless we have a sophisticated theory of vagueness that allows us to do so (as, for example, the epistemic theory of vagueness) we have to accept that species are vague. No panic, though. What is vague is the degree of similarity and not the properties itself of the individuals; in other words, the nature of vagueness has not to be ontological, but can be just semantical.

The context-relativity of our classifications could be explained along the same lines. If an ecologist and a genetist diverge sensibly on the number of species they recognize this is because our knowledge of the issues still has to grow to the point in which we will be able to recognize the 'hard-core' species.

My problem with this reasoning is that it hides the assumption that our classifications are deemed to be provisory and it is this assumption that I regard as highly implausible. It is true that what we today consider as individuals belonging to the same species in some decades or centuries we may consider as belonging to different species. Each of our classification is open to revision. However, this does not imply that they are provisory. They are simply different. According to the relational species concept, species are groups of individuals tied together by a relation of similarity. One could take a privileged perspective, and pretend that what is *really* similar to what can be said only once all the pieces will be at place. But this claim starts losing its force once it is recognized that what is considered similar to what is the result of an intellectual abstraction. Sure, the pigeon in front of my window is similar to the one I have see yesterday at the museum *under certain respects*; but they are also very different under other respects that I may consider very important. For example, they are fed differently and live in different environments. And I take these last two facts to be true of them no less than the probability they have to interbreed within each other or no less than the fact that they have morphological traits they have. Therefore, insofar as the typological account is at place, one can have good reasons to believe that our classifications will eventually get rid of vagueness and context-relativity. But, once a judgement of similarity is introduced, reasons seem to suggest that there is no privileged perspective. Our present species *taxa* have to be considered at face value.

As for the context-relativity, it is important to specify what type of context is at issue. In fact, on the one hand, we surely want our classification to be enough solid. We do not want to change our *taxa* every time that a new organism falls under our consideration or to make them brutally dependent on one's own moral or political trends. Also, unless we have specific reasons to do so, we do not want to consider a revision of our classifications as context-relative, so that both the classification that is settled aside and the one replacing it are considered valid *each from its own point of view*. What we want to allow for is the possibility of holding consistently that two alternative

classifications, supported by different and coexistent research interests, are both true. For example, we want to allow that, given three different classifications of the same organisms, one ecologically oriented, another interested in the overall morphological traits and a third one grounded on genetics, we can conceive of the them as all valid at the same time.

From the point of view of O1, O2 belongs to the same species; but from the point of view of O2, O2 does not belong to the same species. Actual classifications try to avoid a-simmetry and non transitivity, but they can be resolved only contextually – i.e. taking the point of view of O1 or O2.

However, in the case of biological species, one should prefer not to have such a liberal relation. In fact, since the relation of similarity basically cashes out the relation of inclusion into a species, it should reflect our opinions on the latter. Now, I take it that, when we come to inclusion in a species, one does not want to break symmetry: it cannot be the case that a bird *bib* is of the same species that a bird *bid*, and yet *bid* is not of the same species that *bib*. Also, I take it that one does not want and cannot break transitivity. To cope with the many puzzling cases, one can hold that species can have sub-species, so that two organisms within the same species can nonetheless belong to two different sub-species. But it is not the case that a species can branch, so that, to remain with our example, we have a bird *bib* which is of the same species that both *bid* and *bip*, while at the same time *bid* and *bip* do not belong to the same species. Therefore, we want our relation of similarity to be symmetric and transitive and, on this respect, to resemble the relation of inclusion of the typological species concept.

It is not the degree of similarity among its members to individuate a species. In fact, different species may be characterized by the same degree of similarity. What make the relation of similarity of a given species unique are the actual properties of its members. A certain species is a relation of similarity *of certain properties* among a group of individuals. As we shall see, judgments of similarity basically work at two different levels: within a region that we consider relevant; among group of individuals inhabiting different regions. It is hard to say to what extent the two types of levels involve

different patterns of reasoning. Certain rules seem to be the same, others don't. What seem to be kept constant is that, within a given context of judgment, individuals are classified so as to preserve symmetry and transitivity. This is because the individuation of species is a holistic process, in which the single individual under classification is always put into the context of the whole range of individuals to be classified. There is no ideal type member of a species, instead there could be several *exempla* chosen among the whole *spectrum* of variation offered by a single context of judgment. (This is another main divergence from the typological approach to species.) The difference between the two levels of application of similarity is the degree of abstraction. Comparing properties of individuals is different from comparing more abstractly sorted out features of groups of individuals. The second task is, in fact, the one that can more easily comport paradoxes, because the criteria employed within two or three regions taken separately may result in a bad choice once we compare the whole individuals (cfr. Kitcher 1989. More on this later). For example, we may be unclear whether a certain type of bird, lived a hundred millions of years ago, belongs to the same species that a type of bird of which there are still living exemplars. If we were to classify all the birds under consideration at once it could have been clearer to come up with a general criterion of similarity. But, since we have to judge starting from independently led classifications, things are deeply and, in a way, irritatingly vague.

Which type of properties is relevant to define the similarity relation? The choice can sensibly vary and, mainly, reduces to three different alternatives. The first gives priority to an overall comparison of the morphological traits of the organisms (e.g. Ehrlich and Raven 1969). The second is based on their genetic material (e.g. Hull 1978 and Ghiselin 1974). A third party, finally, regards as fundamental the probability of interbreeding (e.g. Mayr 1963). It is important to emphasize that the choice of a type of properties on which to tailor the similarity relationship is at place in *every* classificatory schema. Even proposals like the individual concept of species, whose main advocate is David Hull (e.g. Hull 1965, Hull 1978, Ghiselin 1974 and Kitcher 1989), have to assume some respect of similarity. In fact, even assuming Hull's point of view, we still need some criterion to cut the philogenetic tree into branches.

3. The Relevant Regions (BRANDOM and Mishler, 1987)

The second element characterizing the relational species concept is the division of biological history into space-time regions. Several alternative criteria can do the job. A first one consists in giving priority to temporal distances (Hull 1978). Before considering the degree of similitude between two organisms, the first lived some millions of years ago and the second one still living, it is preferable – one could hold – to put each of them into the context of their "biological era" and look at the similarities that each of them has with organisms lived in their periods. In fact, it is unlikely that two organisms lived at great temporal distance belong to the same species. Another plausible subdivision is grounded on similarity of environments (Van Valen 1976). Carve out the space-time of biological history into environments, and compare first individuals

inhabiting the similar ones. In fact, an environment imposes a certain degree of adaptation to the organisms inhabiting it, so that it is likely that two individuals inhabiting different environments belong to different species. One can also combine these two ways of dividing biological history into relevant parcels and give priority to the types of environments within a certain temporal extension.

The actual individuation of the relevant regions is, however, a more complicated affair. As we know, different organisms can live in different environments. For example, the spatial extension of the environment of a worm is quite smaller than the one of a migratory bird. As for the temporal extension, some organisms live just for few days, so that, within a relatively short time, it is possible to appreciate sensible variations within a species and even some speciation phenomena; on the other hand, some organisms live for centuries, so that speciation events will occur at a much lower rate in time. Clearly, the classificatory activity will take these facts into account, requiring a more and more fine-grained choice of the relevant regions the more information about the organisms under consideration is available. The three way of carving out regions out of the biological history of organisms should therefore be considered as schemas that, from time to time, are integrated with the available knowledge of the environments and the relative times of speciation of the different organisms to be classified.

In general, I take it that a prejudice toward certain space-time regions is always at play in the classificatory activity. A species population can comprehend a large number of individuals. It is unlikely that our similarity judgments will come all at once. One will focus her attention first where it is more likely to find similarities and will try to spell them out just within that region. Only once that this first-level of classification is at place she will be able to consider higher-order similarities.

4. Populations

Once that both a division of the space-time and a type of properties on the basis of which to tailor the similarity relation are at place, we need to specify the criteria by means of which species populations are put together. Fundamentally, this is a two-steps process. First of all, the individuals within a same region are grouped together, on the basis of the type of properties regarded as relevant for classificatory purposes. As I said before, this is a holistic process carried on (ideally) preserving symmetry and transitivity, but tolerating vagueness and context-relativity. It is important to stress that this first-level of classification clearly puts into the whole classificatory process some level of organization. What organisms will be considered as belonging to the same species will be biased by what regions are considered relevant and by how individuals have been grouped within such regions.

The second stage consists in matching up the individuals within different regions so to finally obtain the populations of the different species. In order to do it, besides adopting the relation of similarity, some wants also to put constraints on the

temporal or spatial distance of the relevant regions. Thus, for example, according to the individual species concept, the population of a species must be temporally continuous. This means that species, once disappeared, cannot reappear. Under this respect, they are like any other individual organism that, once dead, cannot come back to life. A second common constraint, at work in the ecological species concept (e.g. Van Valen 1976), is a spatial one. Individuals inhabiting different environments (usually developing different abilities and different morphological traits) cannot count as the same species. Spatial and temporal continuity might, therefore, be required in order for a population of individuals to count as the population of a *species*.

The matching-constraints of individuals across regions prepare the field for comparing such individuals and devise the species populations. The respects of similarity will be the same one employed within each relevant region. To some extent, though, the way it is applied could vary, as the comparison process is carried out at a higher level of abstraction and is dependent on previous choices.

In this way, the relational species concept ends up subsuming under itself the various alternatives to the typological species concept, at the same time making explicit certain of their tacit assumptions. For example, if you favor the biological species concept (e.g. Mayr 1963), then you will employ the probability of interbreeding as the relevant type of properties to judge similarity; however, you will also have to make clear your mind about which spatio-temporal regions you are going to consider more relevant for your classificatory purposes. If you believe in the ecological species concept, you may have some model on how to determine the relevant regions; however, you will also be required to specify the relevant properties on the basis of which to group individuals within each environment. If you believe in the individual species concept, then you will put a constraint on how to group individuals within different regions, but at the same time you will need to specify both the relevant similarity relationship and the relevant regions. Saying that species are individuals is just one third of the story.

5. Typological *vs* Relational Species Concept

The relational species concept proposes itself as an alternative picture to the typological concept. In the same way in which the latter was susceptible of several quite different interpretations, so the former subsumes under itself many other different proposals. This resemblance, however, is not enough to justify the claim that the relational species concept is a general picture of what species are. One could point out that the typological concept has some theoretical import. For example, it is strongly suggesting (if not implying) that to each species *taxon* corresponds a natural kind. Not to talk about how it influences what biologists consider as the goal of their activity and, more broadly, how society in general perceives it. On the other side, what is the theoretical import of the relational species concept? What I hope to have shown so far is that it specifies what is required in order to provide a classification of organisms into species *taxa*. This result has some bearing at several levels of the discussion about the status of species. First of all, it states more clearly the duties of the particular species concepts proposed in the last decades and still used by scientists. To recall an example used before, the analysis revealed that Hull's account of species is not a full account.

More importantly, the relational account is capable of helping us discussing, from a general perspective, puzzles about species. Take, for example, the following paradox concerning speciation, put forward by Philip Kitcher (Kitcher 1989: par. 4). Consider a case of speciation in which there happen to be three groups of organisms, *Gn*, *G1* and *G2* such that, *Gn* exists at time t_n, while *G1* and *G2* co-exist at time t_{n+m}. Also, suppose that, even if both *G1* and *G2* resemble G_n to the same close degree *s*, G_1 differs from G_2 within a quite greater degree than *s*. Accordingly, one should classify G_1 and G_2 as belonging to two different species. But what to say about the individuals in G_n and *G1*? It could seem reasonable to consider them as belonging to the same species. And so for the individual in *Gn* and *G2*. However, if we accept this whole classification, then we break the transitivity of the relation of inclusion in a species. So, do we want to appreciate similarities at the cost of breaking transitivity? First of all, a bolster of the relational account could protest that, by assuming which are the relevant regions, the puzzle is, in a certain sense, assuming its conclusion. In fact, in order to have the three sub-populations described, priority to temporal extent of regions must have been given. If so, then the answer is that, whenever there is a branching in the philogenetic tree, two new species come to exist, as it happens in any case of both sympatric and allopatric speciation. However, the relevant regions could have been individuated in a different way. One could have considered just one big region, occupied by the individuals in *Gn*, *G1* and *G2*. At this point, having the possibility of revising the first level of classification, the judgment of comparison could have taken care of the whole range of variation among individuals and be sensitive to it.

To show that our judgments are and *should be* context-sensitive, consider also this variant. Suppose that after few generations, individuals in *G2* were exterminated by a catastrophe. Then, it seems plausible to say, individuals in *Gn*, *G1* and *G2* would have belong to the same species, with the proviso that the ones in *G2* compose a sub-species. For a bolster of the relational species account, this consideration is non-problematic. We know that our similarity judgments, since they are holistic, are context-relative. On the other hand, a bolster of the typological species account will find puzzling the fact that a certain group of individuals could be classified under different species without any change in their intrinsic properties. One of the two classifications - she will conclude - must get something wrong. I take this difference to be an advantage of the relational account over the typological account. The relational account can make better sense of our actual classificatory criteria.

Finally, I would like to briefly consider the import of the relational species concept on the issue of natural kinds. If the typological concept suggested the existence of natural kinds, the relational one seems to move in the opposite direction. In fact, provided that the properties on which we base the similarity judgments are 'real', the relational species concept considers all the different ways of classifying organisms as equally 'real'. And it does not seem to be the case that each of such classificatory schemas picks out natural kinds. This is because one of the relevant type of properties available for classificatory purposes is the probability of interbreeding, that is a relation among individuals. Now, the status of natural kinds is not less controversial than the one of species; but it is

quite uncontroversial that natural kinds are not relations of the sort of the probability of interbreeding. Therefore, I conclude, the relational species concept suggests that species are not natural kinds; they are just different, compatible and definitive ways of classifying individuals.***[6]***

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[1] I borrowed this list of species concept from a class about "Life System" held at Columbia University in Spring 2003 by Olsen, Russell Gareth and .... I thank them very much for permitting to use their materials here.

[2] For example, (Simpson, 1961), (Kitcher, 1989) and (Dupre, 1993)

[3] Cfr. (Mayr, 1963.)

[4] Cfr, (Van Valen, 1976.)

[5] Cfr. (Hull, 1978.)

[6] I am very thankful to Philip Kitcher and Gareth Russell for helpful discussion and comments on a previous draft.

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